SCIENCE

ELEVENTH YEAR.
VOL. XXI. No. 542.

JUNE 23, 1893.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

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Entered at the Post-Office of New York, N.Y., as Second-Class Mail Matter.

NEW METHOD OF PROTECTING BUILDINGS FROM LIGHTNING.

SPARE THE ROD AND SPOIL THE HOUSE!

Lightning Destroys. Shall it be Your House or a Pound of Copper?

PROTECTION FROM LIGHTNING.

What is the Problem?

In seeking a means of protection from lightning-discharges, we have in view two objects,—the one the prevention of damage to buildings, and the other the prevention of injury to life. In order to destroy a building in whole or in part, it is necessary that work should be done; that is, as physicists express it, energy is required. Just before the lightning-discharge takes place, the energy capable of doing the damage which we seek to prevent exists in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider in this place; but that it exists there can be no doubt, as it manifests itself in the destruction of buildings. The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life.

Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognise the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod, so that it shall aid in this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved

A Typical Case of the Action of a Small Conductor.

Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

SCIENCE

NEW YORK, JUNE 23, 1893.

A STUDY ON PLANT FECUNDATION.

BY H. J. WEBBER, SUBTROPICAL LABORATORY, EUSTIS, FLA.

THE phenomena of fecundation in obscure plants are in themselves probably uninteresting to the general reader. In so far, however, as they bear on the problem of heredity, which has been popularized by the works of Weismann and others, they become of interest to a wide circle of readers and thinkers. This extended interest makes it desirable that the results of important studies should be brought to general notice.

In the study of fecundation in plants, the most important works which have appeared for several years are the studies of Guignard[1] and Treub.[2] These have been summarized in the *Botanical Gazette* and *American Naturalist*.

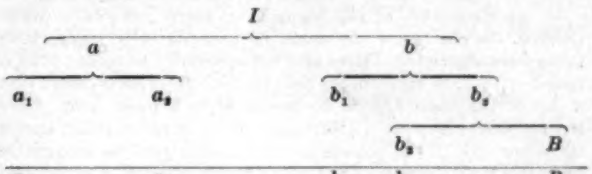
Shortly after the publication of Guignard's studies there appeared a study by Klebahn[3] on the "Fructification of Œdogonium Boscii," an alga of which numerous relatives occur in our American ponds. The article is in no sense revolutionary, yet contains much of interest and value.

A discussion of the occurrence of polar bodies in plants occupies a large part of the paper. This was true also of Guignard's paper mentioned above. Zoölogists found polar bodies to be a very general, if not universal, accompaniment of the animal egg, and they came to be looked upon as having an important *rôle* in the process of fecundation. Botanists now, it appears, discovered that in order to make the theories correspond they must find polar bodies in plants. Following this apparent necessity, for years, every fragment of protoplasm, every small cell or nucleus, anywhere in the region of the egg-cell, for which no other use could be positively affirmed, has been diligently pointed out as probably having the function of polar bodies. To clear up this probable rubbish must now occupy a great share of the attention of botanists writing on related subjects.

Klebahn's study was completed before the publication of Guignard's article demonstrating the presence of attractive spheres (asters) in plants, hence this interesting feature in fecundation is not mentioned.

In the male filament the nucleus lies in the upper end of the cell, the cap end, where the ring and the disunion in the membrane form. In mitosis the upper cell, forming the antheridium, receives only a small amount of protoplasm with the nucleus. After this mitosis the lower nucleus returns to the resting stage, still remaining in its old position, and shortly passes to a new mitosis. This *rôle* is continued till the number (four or five) of antheridium cells are formed. The sterile remainder of the mother cell, after the last mitosis, remains as the lower cell of the series. The protoplast of each antheridium cell divides into two portions, which become the antherozoids. The nuclei of the antherozoids are smaller than those of the vegetative or female cells and have no apparent nucleolus.

In the formation of the oogone a cell of the female filament divides into two daughter cells, an under (a) and an upper (b). These two daughter cells divide again, producing four cells (a_1, a_2, b_1, b_2). The upper one of these (b_2) is the oogonium mother cell. This divides again, and the upper daughter cell of this division is the oogonium (B), and the lower the supporting cell (Stützzelle or Trägerin — b_2). To make this more intelligible, the author's diagram is inserted here:—



In most cases four sterile cells accompany each oogone, but occasionally the cell (a_2) becomes also an oogonium mother cell, the division of which forms an oogonium, A, and its supporting cell (a_2). In this case only two sterile cells accompany each oogone.

The nucleus of the oogonium (B) and of the oogonium mother cell (b_2) are of about the same size and constitution as the nuclei of the vegetative cells. The difference between the nuclei of the oogonium and of the sterile accompanying cells, (b_1) and (b_2), is of especial interest. In the latter the nuclei are much smaller and the nucleolus is always absent. The author especially endeavored to count the number of chromatin bands passing to each nucleus, hoping to obtain some light on Weismann's theoretic reducing division supposed to occur in the formation of the polar bodies. Unfortunately it was found impossible to be sure of the number.

After the oogone has taken its definite form, an opening forms in the upper part for the entrance of the antherozoids. The opening, however, remains closed by an especially developed membrane until the protoplasm of the oogonium draws together into the mature egg-cell ready for fecundation. The nucleus of the oogone meanwhile lies in the upper part of the egg-cell near the point of activity, without, however, dividing or in any evident way giving off substance. The closing membrane now disappears, leaving the way open for the entrance of the antherozoids. Of the numerous cases examined, in no place was anything observed indicating a separation or throwing off of any part of the protoplasm or nucleus. On the contrary, the closing membrane is still present when the protoplast of the oogonium draws together. Nothing in the opening process of the oogonium of this species can be analogized to the formation of polar bodies, and in no stage in the course of fecundation and maturation of the oogone is there anything similar developed.

The antherozoids, passing through the opening in the wall of the oogonium, approach the egg, one fusing with it. Before fusing with the egg-nucleus the male nucleus enlarges from about four to six μ. No other change in structure is noticeable. After the fusion of the nuclei has taken place, the fecundated nucleus is still easy to recognize; the coarser chromatin elements of the male nucleus still forming a well differentiated group. Very soon, however, these marks disappear, the male chromatin becoming distributed till it is wholly unrecognizable. The nucleus of the egg is finally only slightly more strongly granular than the unfecundated. Many antherozoids enter the oogone cavity, but only one enters the egg. Eleven were counted in one case in an oogonium cavity.

The author reviews at considerable length the probable cases of polar bodies in plants, mentioned in literature. The conclusion reached is that at least they do not possess the importance and necessary *rôle* in plants that is assigned to them in the animal kingdom.

It may be possible that in *Œdogonium boscii* the two cells, b_1 and b_2, accompanying the oogonium are to be considered the equivalents of polar bodies. These, with the oogone (B), are de-

[1] Léon Guignard, "Nouvelles Études sur la Fecondation," Ann. des Sci. Naturelles Bot., xiv. (1891), pp. 163-288.

[2] M. Treub, "Sur les Casuarinées et leur place dans le Système Naturel," Ann. du Jardin Bot. de Buitenzorg, x., pp. 145-231.

[3] H. Klebahn, "Studien über Zygoten. II., Die Befruchtung von Œdogonium Boscii," Pringsheims Jahr. fur wissenschaftliche Botanik," Bd. xxiv., pp. 233-267, 1 Taf.

rived from the divisions of the primary mother cell (*b*). They contain but a small quantity of cytoplasm, and are destined for no further development. After holding the oogonium in place for a time they become disintegrated. The similarity of the nuclei of these cells, in particular the supporting cell b_3, to the male nuclei is further very marked. One could easily believe that the nuclear mass which they separate from the egg nucleus becomes replaced by the sperm nucleus. Both cells, *b* and b_3, are, however, not present in all *Œdogoniums*. The supporting cell (b_3) is the only one constantly present, and this is frequently richer in contents, and in one case gives rise to an oogonium.

In the formation of the Antheridia, there remains a sterile nucleus, the one below the chain of antheria cells, from which these were abstricted. Here also the similarity to polar bodies is manifest, but, as Strasburger has pointed out, it necessitates that a part of the male branch be compared to a polar body. The author concludes that a morphological conformity is not shown in either case. The process in *Œdogonium* may be brought in harmony with the theories of fecundation dependent upon polar bodies, but nothing is thus gained.

The results of this portion of the study can be summarized as follows: Genuine polar-body formation is not present in *Œdogonium*. On the other hand, the supposition is not impossible that the two accompanying cells (b_1 and b_2) are the physiological equivalents of polar bodies.

Of the minutia of nuclear fusion in fecundation much remains to be determined. The study lacks the fullness and roundness shown in the work of Guignard. Yet much is added to our knowledge, and our attention is turned to an interesting and promising group of plants for study.

CLIMATE AND THE VARIATION OF SLUGS.

BY T. D. A. COCKERELL, LAS CRUCES, NEW MEXICO.

THE slugs, or naked land-mollusca,—nacktshnacken, they say in Germany,—are found in nearly every part of the world. Many of the species are extremely variable in color and markings, and these variations, as might be expected, usually have a smaller area of distribution than the species to which they belong. Furthermore, as I propose to show in the present article, climate seems to have a marked influence on the variation of these animals, so that the same kind of variety may appear, at two distant spots, under similar environment.

Facts of this kind have been taken, by those who believe in the inheritance of acquired characters, as valuable evidence in their favor. I do not think, however, that they are so valuable in this connection as some have supposed. To cite a well-known example, the white color of many mammals and birds in the Arctic regions is undoubtedly correlated with a cold climate, but it is so very easy to see where natural selection comes in, that scarcely anyone would adduce this instance as proof of the direct influence of climate. So it may be in more obscure cases, where environment seems to directly modify species, that we have not yet found out the way in which natural selection is acting.

In order to be perfectly clear, I will give some examples in as few words as possible, numbering them separately, so that they may be taken one by one, and considered on their merits. I will also attempt to classify them under different headings, according to the kind of environment.

(*A*) *Influence of Altitude.*

1. *Limax marginatus*, Müller. This species is widely distributed in Europe. Its ordinary color is gray, with more or less longitudinal banding. In 1882 Lessona and Pollonera described a nearly black variety from high altitudes in Italy, calling it var. *rupicola*. In 1886 the Rev. A. H. Delap sent me two individuals of this variety from the top of the Reeks, County Waterford, Ireland, 2,300 feet above sea-level. They were at the very summit, miles away from any trees. However, about 100 feet lower down an example of the normal form of the species was obtained.

In this instance it can hardly be doubted that these dark forms originated independently on the Italian and Irish mountains, similar environment producing a similar effect.

2. *Limax maximus*, L. The normal colors are gray with black spots and streaks. A blackish variety (v. *nubigenus*, Bourguignat) is found in the Pyrenees.

(*B*) *Influence of Latitude.*

3. *Parmacella valenciennii*, W. and Van B. Extends from south France to Morocco. In the northernmost part of its range it is reddish-brown, without markings. In the Spanish peninsula the mantle becomes spotted with black (var. *punctulata*, Ckll.), and at Gibraltar and Tangiers the slug is conspicuously marked with black (var. *maculata*, Ckll.). But, curiously, at both the last localities there appears a variety, well marked with black, but dark-olive instead of reddish (var. *olivacea*, Ckll.). It is noteworthy that he varieties on both sides of the Straits of Gibraltar are alike. The var. *olivacea* resembles in color *P. olivieri*, Cuvier, from the Caucasus, at least as represented by an example in the British Museum.

4. *Ariolimax columbianus*, Gould. A large slug found in the Pacific coast region of North America, as far north as British Columbia. In California there is a sub-species, *californicus*, Cooper, identical in color with *columbianus*. From British Columbia to California the slug has two forms, one with, the other without, black spots, the ground-color in each being reddish-brown. In British Columbia there is a variety (*niger*, Ckll.) which is entirely black. In Costa Rica the species reappears as a sub-species, *costaricensis*, Ckll.; dark olivaceous in color. Thus on different continents two slugs, *Parmacella* and *Ariolimax*, each normally rufous, develop an olivaceous variety at the southernmost point of their range.

(*C*) *Influence of Moisture.*

5. *Arion ater*, Linné. This is a large slug common in northern and central Europe. Typically black, it varies to reddish, yellowish, white, brown, and gray, presenting also some beautiful varieties resulting from combinations of these colors. In England one may find specimens of several different colors in the same locality; but Dr. Leach noticed, as early as 1820, that the whitish and pale yellowish forms were specially to be observed in chalky districts. In Scotland, dark varieties prevail. But on the continent, where the climate is drier, is a brick-red form (var. *lamarckii*, Kal.) not to be observed on the British Islands at all. This red variety is so common and conspicuous in various localities in central Europe as to attract the attention of tourists and others who are not usually given to observing slugs.

At Chislehurst, in England, I found intensely black specimens in damp places.

It is possible that the black variety of *Ariolimax* from British Columbia, noticed above, may have some connection with the moist climate of that country.

(*D*) *Influence of Insular Conditions.*

6. *Agriolimax agrestis*, Linné. The common gray garden-slug of Europe, often mottled with dark-gray or black. There is a black variety found in England (var. *niger*, Morel.), and also above the zone of cultivation in the Azores, but not in continental Europe. There is also a very dark variety (*panormitanus*, Less. and Poll.) found in Sicily, and, according to Dr. Simroth, also in Crete. These examples of insular melanism may have to do with the influence of moisture.

7. *Ariolimax columbianus*, Gould. Specimens found by Mr. Hemphill on Sta. Cruz Island, off California, were paler than the type, being uniform light-straw color (var. *straminea*, Hemph.).

8. *Amalia gagates*, Draparnaud. As its name indicates, this slug is typically black, but in England it is nearly always lead-gray (var. or subsp. *plumbea*, Moq.) or brownish, very rarely black. In Sicily there is a large black form (var. *similis*, Ckll.), closely related to the great black sub-species *mediterranea*, Ckll., of Algeria. Here, as with *Parmacella*, we see similar or identical varieties on opposite sides of the Mediterranean. In Madeira, there is a dark-brown variety (var. *maderensis*, Ckll.). In Bermuda, where the species has no doubt been introduced, it is of the typical form. In Ascension and St. Helena are closely-related forms allied to subsp. *plumbea*, and another allied variety (var. *tristensis*, Ckll.) is found both on Tristan d'Acunha and Juan Fernandez.

It is difficult to see how the species can have got to St. Helena,

Tristan d'Acunha, and Juan Fernandez if it was not carried there by man; yet it already shows some divergence from the type, and the specimens from the two latter islands, though they are so far apart, are alike. This is not extraordinary if we assume that like climatic conditions produce like effects, since the two islands are both far out in the ocean, at about the same parallel.

The problem becomes complicated, however, when we find *Amalia gagates* reappearing on the Pacific coast of North America, apparently quite native, though separated by long distances from other localities for the species. This Pacific form generally goes under the name *hewstoni*, given by Dr. Cooper, but I have examined authentic examples, and am convinced it is only *gagates*. Nor is this all, for in Australia and New Zealand are species of *Amalia* so very near *gagates* that some recent students have merged them in it. I have examined *A. antipodarum*, Gray, *A. emarginata*, Hutton, and *A. fuliginosa*, Gould, from New Zealand. *A. emarginata* I consider certainly a form of *antipodarum*, but this and *fuliginosa* appear to me to be valid species. They very much resemble *gagates* in structure, it is true, but, if they are really the descendants of imported slugs, the amount of modification they have undergone is remarkable. *A. fuliginosa* is in the British Museum also from the "Polynesian Islands"—exact locality not stated. There is also an *Amalia* in the Sandwich Islands, evidently very near to *gagates*, but whether identical with it or an endemic form cannot be ascertained in the absence of specimens.

Thus it is seen that *Amalia gagates* and its allies present to us some curious problems, which can only be solved by the collection of specimens from many localities, and their very careful comparison. Because the slug was described from and abounds in Europe, it does not therefore appear certain that specimens found in distant localities, closely resembling *gagates*, are descended from imported examples. We have often good reason for believing that this is their origin, but there is none of the certainty that we feel in regard to other species now found at the antipodes. Quite a similar example is afforded by *Agriolimax laevis* and its allies, which seem certainly native in very widely-separated places. It seems that *A. gagates* and *A. laevis* are very ancient species, surviving in those places where the climate suits them.

A STUDY IN POLARIZATION.—PRELIMINARY NOTE.

BY JOHN DANIEL, VANDERBILT UNIVERSITY, NASHVILLE, TENN.

USING a voltameter with platinum electrodes, separated by a glass partition bored in the centre with a hole two centimetres in diameter, over which was sealed a smaller glass plate bored with a hole one and one-half centimetres in diameter, this smaller hole being covered by metal plates of various thicknesses sealed tight over it, a study has been made of the polarization phenomena upon these thin metal partitions in different electrolytes and under various conditions as to thickness of partition, current strength, temperature, etc.

Without now going into details of the apparatus, methods, and results, the following summarized statement may be interesting:—

1. The polarization on a gold-leaf partition in good-conducting H_2SO_4 is zero, or too small to detect with our apparatus, for the range of current used.

2. The "critical thickness" in good-conducting solutions of H_2SO_4, $CuSO_4$, and NaCl is *greater* than .00009 millimetres for gold; .00015 millimetres for platinum; and .0005 millimetres for aluminum, under the above conditions. It is *less* than .0004 millimetres for gold; .002 millimetres for platinum; and .002 millimetres for silver.

3. The "upper critical limit" of thickness under these conditions seems to be about .004 millimetres, rather less than No. 3 gold.

4. Tables I., II., and III. all point to the conclusion that between "critical limits" of thickness the polarization for a given current increases with the thickness.

5. Table II., showing relation of polarization to current, expresses two interesting facts: (*a*) that the polarization on "thick" plates is about the same, in this voltameter, for all currents between .2 ampere and, say, .01 ampere, provided time enough be allowed in each case for the current to become constant, i.e., between the upper limit of current, at which the development of gas is so profuse as by mechanical obstruction and irregular escape to interfere, and the lower limit, at which the formation of gas is no faster than it can be dissipated. (*b*) Quite different is the case for "thin" plates, where, within the limits of current and thickness prescribed, the polarization is dependent upon the current and gives for each thickness a different curve, or rather straight line, for they are all straight lines converging to the origin, and differing only in *slope*. The current strength at which the polarization on very thin plates would reach a maximum is far above that used, being, perhaps, expressed in amperes instead of tenths and hundredths.

By *thick* plates are defined those above the "upper critical limit;" by *thin* plates, those below this limit of thickness.

6. Inspection of Table III., which gives the time-change of the polarization, will show a similar distinction between "thick" plates and "thin" plates, as was noted in the last paragraph, viz., that for thick plates the change is considerable and continues slowly for hours; for thin plates, the change of polarization with time is both less pronounced and extends over much less time.

7. It was noted, especially in the case of $CuSO_4$ as electrolyte, that there was polarization on gold-leaf if the gold exposed came in contact with the solution some distance beyond the edge of the hole in the glass plate to which it was sealed; thus in $CuSO_4$, for the stronger currents used, there was a symmetrical deposit of Cu, decreasing in thickness from the outside toward the centre, and vanishing at a small distance from the edge of the hole, this distance being less the stronger the current. If only one corner was left exposed, the Cu was deposited there. This phenomenon was further tested by bending a thick strip of aluminum, 4 centimetres long, into the shape of a narrow U, and simply hanging this U in the *open* hole of the glass partition, in $CuSO_4$, and closing the circuit on the voltameter; the two ends of the metal strip being thus in contact with the $CuSO_4$ on opposite sides of the glass two centimetres from the edge of the opening, there was decided deposit of Cu on one end and escape of oxygen from the other end.

8. In $CuSO_4$, all the plates except those below the critical thickness were destroyed by oxidation. No. 1 silver was destroyed is less than one minute. Of course, gold and silver above the critical thickness could not be used in NaCl, because of chemical action, though the thinnest plates were quite unaffected. Only the No. 7 gold was tested in KOH, as it dissolved the sealing-wax.

9. Thick plates of gold were strongly oxidized in H_2SO_4, especially with strong currents. Thin gold plates were apparently only oxidized under action of strong or long-continued currents. Compare Tables II. and III. Silver was even more easily oxidized than gold. Aluminum was so intensely oxidized by the current that no satisfactory measurements could be made for this metal, though the thin foil was unaffected.

10. With H_2SO_4 as electrolyte, after a thick plate of pure gold had been used as partition for the time-change of Table III., the end cathode was found to be gilded. A thick Pt plate being then substituted for the gold in the same solution for the results of No. 1 Pt in Table III., the Pt partition was found, on removal, to be gilded. The polarization for No. 1 Pt in this case was somewhat less than for the same Pt after both it and the end electrodes were thoroughly cleansed, the electrodes re-platinized, and fresh solution made.

11. The polarization in $CuSO_4$, using Cu electrodes, reached a maximum almost immediately and remained very constant. The maximum polarization for thick Pt in $CuSO_4$ was hardly 75 per cent of that for the same in H_2SO_4. In NaCl the polarization became constant very quickly also, but its value was decidedly greater, especially on thin plates, than in H_2SO_4; though the same distinctive behavior of thick and thin plates was maintained.

12. In H_2SO_4 of different concentrations the maximum polarization for a partition was of the same order of magnitude; but its value for very weak currents was decidedly greater in weak solu-

tions than for the same current in stronger solutions, up to 30 per cent. This shows itself especially with thin plates, and also in the shorter time required for thick plates to reach a maximum polarization with weak currents. The greater change in temperature and the greater change in concentration of weak solutions may account for this.

For currents between 0.1 and 0.2 ampere, the polarization on the end electrodes was:—

For H_2SO_4, 1.84;

" NaCl, 1.98;

" $CuSO_4$, 0.00, with Cu electrodes, though, if the current density was too great or the time long, the anode would oxidize and become irregular. C. Fromme, in a paper, "Ueber das Maximum der galvanischen Polarisation von Platinelektroden in Schwefelsäure" (*Annalen d. Physik u. Chemie*, Band XXXIII., s. 80–126), states that the maximum polarization varies both with the concentration and the relative size of the electrodes, the extreme limits being given as 1.45 to 4.31 volts—the minimum polarization coinciding with maximum conductivity. His method for measuring polarization was somewhat similar to that used in this work. As bearing upon "the change of polarization with time," I would refer especially to the investigation of Dr. E. Root upon this subject, discussed by Professor von Helmholtz, *Wisch. Abh.*, Vol.I., page 885. These experiments by Dr. Root seem to prove clearly that the liberated ions penetrate deeply into the electrode, even when liberated upon but one side of it, as in this case. I take great pleasure in expressing here my thanks and deep obligation to Professor A. Kundt and Dr. L. Arons for their kind sympathy and direction in this work.

Using $CuSO_4$ on one side of the partition, and H_2SO_4 on the other side, careful determinations have developed the curious fact that, although there is no visible development of ions (neither Cu nor O) at the gold-leaf partition, yet the Cu does not pass through the gold-leaf with the current, but H appears on the cathode instead, provided the current density at the partition be not greater than about .3 ampere per square centimetre.

The "critical current-density" at which the ions just begin to appear visibly on a gold-leaf partition varies for different electrolytes between the limit of 5.7 amperes for 30 per cent H_2SO_4 and sensibly zero for lead acetate.

This "critical current-density" is proportioned to the conductivity of the electrolyte. It therefore also has a decided positive temperature co-efficient.

ON THE FORMATION OF ALUMINUM SULPHATE IN THE SHALES THROWN FROM COAL-MINES.

BY M. H. LOCKWOOD, ASSISTANT IN THE DEPARTMENT OF GEOLOGY AND MINERALOGY, MISSOURI STATE UNIVERSITY.

My attention was recently called to a white crystaline formation found on and between the layers of a red-colored shale that is much used for walks in Columbia, Mo., and is obtained from the old waste heaps of coal-mines in the vicinity. Upon examination I found it to consist of aluminum sulphate, which is readily soluble in water, and has an alum-like taste. Occasionally some iron sulphate is present. The question arose as to how the aluminum sulphate was formed in between, and on, the layers of the shale.

For the purpose of studying the formation, I visited the Reece mine at Henry Station, on the Wabash railroad, and there collected the following waste materials as thrown from the mine, viz., fire-clay taken from below the coal, clay-parting from a layer about six inches from the bottom of the coal seam, iron pyrites mixed with coal from spots throughout the coal seam, clay containing iron pyrites and carbonaceous matter from just above the coal, and a blue argillaceous shale from above the coal.

The waste materials thrown from the mine, and exposed to the air and moisture, go through the process of slacking or burning, and it is during this process that the aluminum sulphate is formed. I also collected specimens from the burned and from the burning heaps about the mine.

Upon examination of the fresh specimens I found that the fire-clay contained no free aluminum compound that would form aluminum sulphate after the slacking or oxidation of the heaps. The clay-parting and other specimens containing iron pyrites and carbonaceous matter, will oxidize so rapidly when exposed to the air that the mass takes fire and we have iron sulphate and sulphuric acid formed. The sulphuric acid combines with the aluminum in the shales and clays about it, forming aluminum sulphate which crystalizes on the surface.

The shale from above the coal contains some simple compound of aluminum (probably the hydrate), and a considerable quantity of free sulphur. The presence of the aluminum was shown by the cobalt-nitrate test, and, also, when some of the shale was boiled with hydrochloric acid and filtered, the solution gave a white precipitate of aluminum hydrate upon the addition of ammonium hydrate.

Some pieces of the shale contained so much free sulphur that they would burn, upon ignition, with a blue flame, giving off fumes of sulphur dioxide. When some of the powdered shale was leached with carbon dioxide, and the solution evaporated, a residue of sulphur was obtained. These tests indicate that the sulphur and aluminum thoroughly penetrate the shale. When the heaps burn the sulphur becomes highly oxidized, and combines with the aluminum, forming aluminum sulphate within the shale. Heat drives the aluminum sulphate to the surfaces, hence it will crystalize between the layers and on the surfaces of the shale.

Free sulphur is found deposited in a crust at the top of the burning heaps. This shows that there is an excess of free sulphur in the waste materials.

The red color of the shale is due to the red oxide of iron formed when the water is driven off by the heat.

CURRENT NOTES ON ANTHROPOLOGY.—XXX.

[Edited by D. G. Brinton, M.D., LL.D., D.Sc.]

Prehistoric Ethnography of Northeastern Africa.

THERE are two very learned and suggestive articles in the *Beiträge zur Assyriologie*, Bd. II., Heft II., 1892, which may be combined to present the latest substantial opinions on the relations and sequence of linquistic stocks in the valley of the Nile and the lands adjacent. The one is by Franz Pastorius, on the Hamitic languages of East Africa; the other on the relations of the Semitic and Old Egyptian languages, by Fritz Hommel. In what I present on the latter theme, I have also had the advantage of a paper read before the Oriental Club of Philadelphia, by the able egyptologist, Professor W. Max Müller.

Scarcely any question in early ethnography could be more important. It touches directly on the origin of the two oldest civilizations of the world,—the Egyptian and the Babylonian. According to Hommel, the Old Egyptian of the Pyramid Texts, and the Old Babylonian (Semitic) tongues agree so closely in grammar, in sequence of words, in phonetics, and in lexicography, that their near relationship or their common origin must be admitted. Professor Müller informs me that in the Egyptian of the Rammesside epoch at least sixty per cent of the words in use were clearly Semitic. These relations are, however, distinctly not with the western Semites, but directly between the eastern Semitic (Babylonian) and the Old Egyptian. Hommel very pertinently adds that this by no means justifies the conclusion that the original home, *die ursprüngliche Heimat*, of the common stock was in the valley of the Euphrates; it might just as well have been on the Nile.

Some strength is given to the latter possibility by his comparisons of the Old Egyptian with the Berber dialects. He finds that the lexicon of these latter is Old Lybian, but that their grammar and syntax are very closely related to the Old Egyptian. There is no doubt but that the characteristic forms of the perfect and imperfect tenses were at one time common to the Berber, the Old Egyptian and the Semitic tongues. Besides these, as pointed out by Pastorius, the Hamitic (or Berber) dialects had in common with the original Semitic the personal pronouns, the feminine in *t*, and a number of minor structural elements. He is convinced that the East African Hamites (sometimes called Kushites) have been dwellers on the upper tributaries of the Nile, in Abyssinia, for many thousand years. Of their dialects,

the Somali and Galla are much the most profoundly semitized, the Saho and Afar (Danakil) much less so. All these dialects stand in close relationship to the geographical features of the country, showing that they originated on the spot. They have both influenced, and been influenced by, the Amharic (Ethiopic) Semitic stock, and to some extent by the Soudanese tongues. *Pari passu* with the language, the blood of the tribes has suffered from this intermixture.

The extreme interest of these conclusions cannot but impress all Semitic and Egyptologic students.

Fossil Human Remains in South America.

The critical scrutiny of the evidence of paleolithic man in North America, which has lately occupied considerable attention, has perhaps been pushed too far. When, as in the Ohio field, discoveries have been made which cannot be gainsaid, it is scarcely fair to prefer every conceivable explanation of them to the simplest one — that the articles were originally deposited where found.

Meanwhile, in South America, some interesting facts are communicated by Mr. Roth, of Buenos Ayres, to Professor Kollmann, and published by him in the Mittheilungen aus dem Anatomischen Institut, at Basel. Mr. Roth was the discoverer of the skull of "Pontimelo," which, by the way, he informs us is a typographical error for "Fontizuelos." This skull, together with some other human bones, was found under the carapace of a glyptodon of extinct species, and Mr. Roth argues that the man and the animal were contemporaries. He does not seem to have contemplated the possibility that men of later times may have found the carapace, and with it piously covered the remains of one of their dead. He asserts, however, that Döring, Burmeister, Ameghino, Moreno, and other leading geologists of the Argentine Republic, have acknowledged the contemporaneity of man and the glyptodon.

Roth cites a number of instances where human remains have been found in the upper Pampas formation. In 1887, he unearthed for the first time some in the middle Pampas strata; and, in the same, both he and others have found numerous pieces of pottery, an artificial shell-heap, and occasional silex points of human workmanship. He insists that there is no room for doubt that whenever the so-called "Pampeano Intermediar" was deposited, man was then living there. This time, if Ihering is right (see my note in *Science*, April 14), was in Pliocene (tertiary) days.

Professor Kollmann brings this into connection with other early finds in South America, and reaches the conclusion: "That the discoveries of ancient human remains in America prove that the various American races inhabited their continent quite as remote in time as did those of Europe and Asia, their respective localities;" which expression leads to the inference that he is a polygenist, or, else, seeks the cradle of the species outside these three continents.

The Ethnic Origin of the Jews.

In spite of the persistency of the typical Jewish physiognomy, it is proved by history that the Jews are far from a pure Semitic strain. They lived among and constantly intermarried with the Canaanites, Amorites, Philistines and true Hittites, none of whom were of Semitic blood; they bought Greek concubines, called in the Bible "pilegesh"; and, in turn, the males of many of the tribes around them, lured by the ever famous and still maintained beauty of the Jewish maidens, were quite willing to vow, "Thy people shall be my people, and thy God my God." In the Talmud these are called "proselytes of the King's table," and they were accorded honorable positions.

Such conversions by no means ceased with the destruction of Jerusalem by Titus. In the eighth century, Bulan, Prince of the Chasars, with all his people, embraced Judaism, and the repeated edicts in medieval time forbidding marriages between Christians and Jews can only be explained because such unions led the former to the faith of the latter.

At present, in all parts of the world, the prevailing anatomical type of the Jew is that of the brunette, with curly dark hair, dark eyes, often olive complexion, the skull long — dolichocephalic — the face rather narrow. This holds good for about ninety per cent of them; but nearly everywhere the remaining ten per cent — in Germany, over eleven per cent — are blondes, with light hair and eyes and round skulls — brachycephalic. In a much smaller percentage, the type is characteristically Mongolian, especially in the women, and about an equal number present negroid features. These aberrations from the ethnic type must be regarded as reversions through heredity to some of the numerous non-Semitic strains, which have, as above intimated, from time to time modified the pure current of Hebraic blood. That in spite of the number and extent of these admixtures the type has been preserved on the whole with such fidelity from the earliest Babylonian epoch, is a remarkable lesson in anthropology. An interesting discussion of the whole question by Von Luschan, Virchow and Alsberg may be found in the *Correspondenz-Blatt der Deutschen Gesellschaft für Anthropologie*, October, 1892. It effectually disposes of the absurd theory of Professor Gerland, of Strasburg, that the Semitic stock is a derivitive from the African negro — a theory which can only be explained by an anomalous degree of anti-Semitism obscuring his intellectual faculties.

NOTES AND NEWS.

A MEMBER of the Anthropological Society of Washington has placed in the hands of the treasurer of the society a sum of money to be awarded in prizes for the clearest statements of the elements that go to make up the most useful citizen of the United States, regardless of occupation. The donation has been accepted and the society has provided for the award of the following prizes during the present year (1893) under the following conditions: Two prizes will be awarded for the best essays on the subject specified above, viz.: A first prize of $150 for the best essay, and a second prize of $75 for the second best essay among those found worthy by the commissioners of award. These prizes are open to all competitors in all countries. Essays offered in competition for the prizes shall not exceed 3,000 words in length, and all essays offered shall thereby become the property of the Anthropological Society of Washington, the design being to publish the essays, at the discretion of the Board of Managers, in the official organ of the society, the *American Anthropologist*, giving due credit to the several authors. Each essay should bear a pseudonym or number, and should be accompanied by a sealed envelope bearing the same pseudonym or number, and containing the name and address of the competitor; and the identity of competitors shall not in any way be made known to the Commissioners of Award. Essays must be typewritten or printed, and must be submitted not later than November 1, 1893. While it is not proposed by the society to limit the scope of the discussion, and while each essay will be considered on its merits by the Commissioners of Award, it is suggested, in view of the character of the society and the wishes of the donor of the prize fund, that the treatment be scientific, and that the potential citizen be considered (1) from the point of view of anthropology in general, including heredity, anthropometry, viability, physiological psychology, etc.; (2) from the point of view of personal characteristics and habits, such as care of the body, mental traits, manual skill, sense training and specialization, and all-around manhood; and (3) from the ethical point of view, including self-control, humanity, domesticity, charity, prudence, energy, *esprit de corps*, patriotism, etc. The essays offered in competition for the Citizenship Prizes of the Anthropological Society of Washington will be submitted, on or about November 2, 1893, to five commissioners of award, including, it is proposed, one anthropologist, one jurist, one statesman, one educator, and one other not yet specified, all of national reputation, of whom at least one and not more than two shall be members of the society; and the award shall be made in accordance with the findings of these commissioners. Essays submitted in competition for the prizes should be delivered not later than November 1, 1893, to the secretary of the Board of Managers of the Society, Mr. Weston Flint, No. 1101 K street, N. W., Washington, D. C., to whom all correspondence relating to the prizes should be addressed.

SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

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THE SEDIMENT OF THE POTOMAC RIVER.

BY CYRUS C. BABB, U. S. GEOLOGICAL SURVEY.

THE United States Geological Survey in May, 1891, established a gauging station on the Potomac River at Chain Bridge, D.C., for the measurement of the discharge of the river at that place. From that date to the present time daily readings of the height of the river have been maintained, which, taken in connection with the measurements of discharge, makes it possible to compute the daily discharges of the river at this place. A detailed account of the methods and results of this branch of the work may be found in a paper by the writer in the Transactions of the American Society of Civil Engineers, No. 537, Vol. 27, and entitled "The Hydrography of the Potomac River Basin." This article deals with the discharge of the river and its relation to the rainfall in the basin. It is also stated that measurements of the amount of sediment transported by the river were being made. The results are now available and are here given for publication.

Daily heights of the Potomac River at Great Falls, about sixteen miles above the City of Washington, have been kept since 1878 by the officials of the Washington aqueduct, together with a daily record termed "condition of water." Owing to the fact, however, that the dam across the river at Great Falls was not completed until 1886, the two sets of records previous to this latter date are valueless for discussion.

The results of this article are based in part upon the records of "condition of water," which are made as follows: A horizontal metallic tube, 36 inches long and with glass ends, is filled with water, and the distance at which a ball immersed therein can be seen from one end is noted. The observations vary from 1 inch in very muddy water to 36 inches, which is considered as clear. Samples of the river water at Great Falls were collected and were sent in to the main office in Washington, where they were analyzed quantitatively in so far as the determination of the ratio of the weight of the contained sediment to the total weight of the sample. At the same time the "condition of water" was recorded. Fifty-five samples were analyzed, with condition of water ranging from 1 to 36 inches. These quantities were plotted on cross-section paper, with condition of water as abscissæ and ratios of sediment to water as ordinates. Through the points thus obtained a smooth curve was drawn, from which a table was constructed, giving for each inch of condition of water the corresponding ratio of sediment. In order to obtain the total amount of sediment transported by the river for any length of time the discharge of the river for that period must be multiplied by the average ratio of the sediment to the water for the same period.

Simultaneous gauge readings of the height of the river at Great Falls and at Chain Bridge were maintained for a year and a half. From these observations a table was constructed, giving for the gauge height at one place the corresponding gauge height at the other. From the fact that no large tributary enters the river between these two points, the daily discharges at Great Falls may be computed from the table of gauge relations and from the daily discharges of the river at Chain Bridge. The daily ratio of sediment to water was found from the daily record of condition of water and the rating table of ratios and condition of water. Knowing then the daily discharge of the river in cubic feet per second and the daily ratio, it is simply a matter of multiplication of second-feet times the ratio times the weight of one cubic foot of water to obtain the weight of the total amount of sediment passing down the river per second. In this way the daily amounts of sediment from 1886 to 1891, inclusive, have been computed.

In considering the value of these figures, it would seem at first sight that the above method of measurement for condition of water was crude to base scientific results upon. The observations are not made for that purpose, but are more for the benefit of the fishermen in the vicinity of Washington. They have the advantage of being simple and inexpensive and can be maintained by an inexperienced observer. Another very important fact in their favor for this river is that, owing to the absence of lakes and extensive swamps throughout the basin, such as are found in the glacial region further north or the swampy regions of the extreme south, the coloring matter of this river is almost wholly due to mineral sediments and very little to vegetable deposits. It would be more accurate if daily samples of the water could be analyzed, but it would be expensive and would require a long time-interval before the results would be of value. There is a six years' record of condition of water, or over 2,000 observations. From a series of measurements certain average values for this record have been computed. Any one observation may depart greatly from this average, but when considered in connection with the total number of observations the effect of its departure from the mean is inappreciable.

The lowest record is 36 inches. In some cases the ball is just able to be seen at this mark; in others distant objects are plainly visible. There is here an arbitrary limit for the curve, which ought to extend considerably below this point, but taken in connection with the rest of the range, and especially with the upper part, where the ratios are large, the weight of this lower end is small. Errors will also arise depending upon the cloudiness of the day. However, errors due to this method of sediment measurement are not cumulative, but may be either plus or minus, and in a large number of observations tend to equalize each other.

It is therefore considered that the results are sufficiently accurate for all ordinary purposes.

The following facts are brought out. The average annual discharge of the Potomac River from a drainage area of 11,043 square miles is 20,160 second-feet, varying from 2,000 second-feet in time of low water up to 470,000 second-feet during the great flood of 1889. The total annual amount of sediment transported is 5,557,250 tons, or 353 pounds per second, and distributed through the six years from 1886 to 1891 as follows: 1886, 4,283,000 tons; 1887, 2,372,800 tons; 1888, 4,996,800 tons; 1889, 10,142,600 tons; 1890, 5,994,000 tons; and 1891, 5,544,200 tons. The average daily amount varied from 1 pound to 21,900 pounds per second. It is found from these figures that the average annual amount of sediment is to the weight of the annual discharge of water as 1 to 3,575. Assuming that one cubic foot of sediment weighs 100 pounds, this average amount of sediment would cover one square mile 3.98 feet in depth, and if spread over the drainage area would cover it 0.0043 inches in depth. At this latter rate it would take the river 2,770 years to erode one foot from the drainage area.

These results appear in the following table, together with similar data compiled for several other large rivers. The first column gives the name of the river; second, its drainage area in square miles; third, the average annual discharge of the river in cubic feet per second. The fourth column gives the total amount of sediment, in tons, annually transported by the river; fifth, the ratio of the weight of this sediment to the weight of the water annually discharged; the sixth, the height of a column in feet having a base of one square mile that the sediment would cover; the seventh, the depth in inches that the drainage area would be covered if this total amount of sediment should be spread over it; and the last column the authority for the data. The discharge

and drainage areas for the Rhone, Po, Danube, and Uruguay are taken from a paper by John Murray in the *Scottish Geographical Magazine* for February, 1887. The drainage area of the Nile was measured by planimeter from the best maps obtainable.

Discharge and Sediment of Large Rivers.

River.	Drainage Area, square miles.	Mean Annual Discharge, second-feet.	Sediment.				Authority.
			Total Annual Tons.	Ratio by Weight.	Height column 1 square mile base, feet.	Depth over Drainage Area, inches.	
Potomac	11,43	20,16[a]	5,557,250	1:3573	4.0	.00433	
Mississippi [1]	1,214,000	610,000	406,250,000	1:1500	291 4	.00288	Humphreys and Abbot
Rio Grande [2]	80,000	1,700	3,830,000	1:291	2.8	.00110	U. S. Geological Survey
Uruguay	[3] 150,000	[3] 150,000	14,782,500	[3] 1:10,000	10.6	.00085	J. J. Revy
Rhone	[3] 34,800	[3] 65,850	[4] 86,000,000	1:1778	31.1	.01071	J. Barois
Po	[3] 27,100	[3] 69,200	[4] 67,000,000	1:900	59.0	.01139	"
Danube	[3] 320,300	[3] 315,2 0	[4] 108,00 ,000	1:2880	93.2	.00354	"
Nile	1,100,000	[7] 113,000	[4] 54,000,000	1:2050	38.8	.00049	"
Irrawaddy [6]	125,000	475,000	291,430,000	1:1610	209.0	.02006	R. Gordon

GLACIATION IN PENNSYLVANIA.

BY EDWARD H. WILLIAMS, JR., LEHIGH UNIVERSITY, SO. BETHLEHEM, PA.

Owing to the difference of opinion regarding glaciation in this vicinity, I have taken the subject for the out-door work of the post-graduates in the mining course, during the past few months, as their geological survey, and I make now a preliminary statement of what has been found, without theorizing upon it in any way, as the work is to be continued and extended to adjoining regions.

The Lehigh University is situated on the north slope of what is called The South Mountain, or the Durham and Reading Hills, immediately back of South Bethlehem, Pa. The crest of the same varies from 665 to over 900 feet above tide, at the point mentioned. This is above the reach of glacial deposits by floating ice. To the north lies the great valley bounded by the Blue Ridge, and just north of this is a lower ridge of Oriskany sandstone in a vertical position. The nearest portion of this sandstone is therefore beyond the Blue Ridge. As the rocks of this ridge are mainly barren, while the Oriskany sandstone carries the usual fossils, this formation was taken as a test-rock, owing to the fact that the rock called Potsdam sandstone sometimes weathers so as to greatly resemble rocks of other formations.

Professor Salisbury stated that he had found glaciated stones 500 feet above the Lehigh River, on the mountain back of the University, and adduced that fact to refute the statement of Professor Wright, that the ice failed to come as far south as Bethlehem. The height of the point noted was proof that the specimen had not been brought by water, and that the ice-sheet had extended across the great valley. From this was deduced the idea that there had been two periods of glaciation, and that the one marked by the terminal moraine north of us, was the later of the two.

To the south of that part of the mountain back of the University, lies a land-locked valley, so that there was no drainage southward, except at high levels, during the time when the bowlder clay was deposited and therefore there would be no current to divert icebergs into that valley and cause a universal distribution of that clay, as there is to the north of the South Mountain.

The preliminary work shows that Oriskany pebbles and bowlders are found at all altitudes over this mountain, and the great majority of the smaller ones lie in a clay, which may be due to the decomposition of the gneiss of the mountain; but which exists on the top of the highest part of the ridge. These have been traced into the Saucon Valley to the south as far as a line running from Friedensville to the second railroad cut south of Bingen. South of that line we find the clays from the subjacent limestones generally free from foreign stones, as far south as Centre Valley, the southern part of the survey. North of that line we have found four lines of glaciated material. In the valleys these run across all the formations from gneiss to limestone, in lines generally parallel, and with a freedom of glaciated material except in the lowest parts, where ice may have been present. Oriskany bowlders are found of considerable size, and in some parts abundantly. Only one of these lines has been traced fully, and that runs from the north of Bingen and at an elevation of about 300 A. T., across the Saucon Creek and Valley, and, passing south of Seidersville, has been followed to the summit of a hill west of the latter place, and at an elevation of 720 A. T.

It is comparatively easy to trace these lines, as the farms are provided with wooden and wire fences, except where these lines exist, and there the fences are of stone heaps, and the soil is stony. Digging under these lines shows that they are resting on rock in some cases, and on soil in others.

It may be said that the ice went over the South Mountain. In this case there has since been a great disintegration of the gneiss, as the cuttings for the South Bethlehem reservoir show 25 feet of rotten rock in some places. It may be said that these are evidences of a older glaciation; but this older intrusion followed exactly the lines of the later one, as can be seen by running a line from the points in New Jersey noted by Professor Salisbury (Pattenburg, etc.) to Seidersville, Pa., so that the advocates of a single period can say that this was a sudden intrusion for a short period followed by rapid retreat for twenty miles.

This work is not sufficiently extended to furnish data for theorizing, and it will be extended in the future; but attention is called to the fact that here exists a good field for observation, as the rocks of the country (gneiss quartzite and limestone) cause intrusive rocks from the Blue Ridge to be very prominent.

INFLUENCE OF PARASITES ON OTHER INSECTS.

BY G. C. DAVIS, AGRICULTURAL COLLEGE, MICH.

From a philantrophic standpoint, it seems cruel to see one class of insects preying upon another. The eager female parasite is so vigilant in her search that one would think a subject of her search could not escape till it had reached maturity; yet strategy, mimicry, offensive odor, hairy and other coverings, and many other peculiar and interesting methods of protection help to shield and protect the invader from its insidious foe till out of danger. In watching the ups and downs of the two from year to year, about the only effect that is noticeable is that the parasite generally holds the balance of power, though usually the balance is well equipoised.

Viewed from an economic and practical side, the practice loses its cruel aspect and is encouraged and fostered in many ways, as it means an inexpensive control of many of our common pests. There is little doubt but parasites do much more good than we are wont to give them credit for. In a large share of the cases of parasitism, about so many individuals of a species are parasitized each season, and the number left remains too small to produce serious damage. On the other hand, if the species had no parasite to contend with, it would soon be numerous enough to be a dreaded pest.

Very often certain species do appear in greatly increased num-

[1] "Report upon the Physics and Hydraulics of the Mississippi River," by A. A. Humphreys and H. L. Abbot, Philadelphia, 1861, p. 149.

[2] "Eleventh Annual Report U. S. Geological Survey," Washington, 1891, Part II., p. 57.

[3] Scottish Geographical Magazine, February, 1887, p. 76.

[4] "Irrigation in Egypt," by J. Barois, translated by Major A. M. Miller, Washington, 1889, p. 18.

[5] "Hydraulics of Great Rivers," by J. J. Revy, New York, 1874, p. 135.

[6] "Report on the Irrawaddy River," by R. Gordon, Rangoon, 1880, Part III. p. 25.

[7] Special Consular Reports, House of Representatives, 51st Congress, 2d Session, Ex. Doc. 45, Part I., p. 250.

bers, and cause widespread consternation. No doubt climatic and other influences have much to do with these sudden up-risings, as we find species that are known to be parasitized but very little, which fluctuate in numbers greatly with different seasons. All the effect, then, cannot be attributed to parasites.

The difference between the work of parasites and other influences, is quite marked and distinct in certain channels, and can be easily traced. The tendency of parasites is to increase or decrease in numbers as the host is numerous or scarce. A few years ago the wheat aphis was so numerous over the wheat plants that it threatened to destroy the whole crop in this region. Presently certain of the aphis looked brown and swelled, which told plainly that the parasites were there too. The wheat grew and headed. Still the aphis increased by the thousands daily, and the parasites increased in numbers also. Then there came a time when the parasites were in the majority, and, before the wheat-heads had ripened, a live aphis was a scarce and hard thing to find. The next year the wheat aphis was not common, and what did appear were disposed of early by the parasites.

Sometimes the work of the parasites is not as prompt as the instance just cited. For illustration, the oak army worm, *Edema albifrons*, was never known to be numerous enough to greatly injure the oak till two years ago, when the species came in such numbers as to strip whole forests of their foliage. Of the several hundred caterpillars and pupæ collected, only one pupa was parasitized. Last year the trees were again stripped by countless numbers as the year before, but from the pupæ collected, about every one in ten was parasitized. Probably this year the caterpillars will be less numerous, and by next will be scarse, because of the work of parasites.

An ideal parasite is one that would keep its host in such complete subjection that no outbreak would occur, and the numbers not great enough to do any harm. While the effect of parasitism is not ideal in every respect, it nevertheless is a boon to economic entomology, and has already been used to good advantage, by introducing many foreign parasites that are known to work on certain species. As we become still more familiar with these parasites and their hosts, much more good, through parasitic species will undoubtedly result.

EARTHQUAKES IN AUSTRALASIA.—II.

BY GEORGE HOGBEN, M.A., SECRETARY OF THE SEISMOLOGICAL COMMITTEE OF THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In my former communication I explained the nature of the work that the Seismological Committee of the A. A. A. S. proposes to do anent earthquakes. In the present contribution I shall endeavor to sketch briefly what has already been done for New Zealand earthquakes.

The committee has published two reports, 1891 and 1892. The former was drawn up by Sir James Hector, F.R.S., and deals with New Zealand earthquakes to the end of the year 1890. It contains a list of earthquakes (537) felt in New Zealand from the earliest settled times, and gives interesting details concerning the somewhat severe shocks of October, 1848, and January, 1855. The last-named is notable as being one of the few in any country in which movement of the land has been actually observed by skilled observers on the spot. Captain Drury, R.N., was engaged at the time on the nautical survey of the New Zealand coast, and, being in the neighborhood of the land raised, was able by actual re-measurement to confirm the general impression. "An area of 4,600 miles was estimated to have been raised from one foot to nine feet, the greatest elevation being on the west side of the Wairarapa Valley, the vicinity of Porroria Harbor not being affected, and the west side of Cloudy Bay, north of Blenheim, having actually been depressed to the extent of five feet." (Transactions, A. A. A. S., 1891, p. 532). The elevation has been permanent. The same report (1891) contained a map by Sir James Hector, showing the seismic areas, principal fault and earthquake-rents in the Islands of New Zealand. The division into seismic areas is not, however, based upon the determination of the earthquake origins, and, in the opinion of the present writer, is on that account misleading. At the same meeting of the Australasian Association (Jan., 1891), I read a paper on New Zealand Earthquakes, which contained a somewhat larger list (775) than the report of the committee, together with two maps and a diagram showing curves of monthly seismic frequency, the New Zealand curve based upon the records of 745 shocks being compared with Mallet's curves for the Northern and Southern Hemispheres — 5,879 and 223 earthquakes, respectively — (See Milne on Earthquakes, p. 256). The record for New Zealand shows a maximum of frequency in September, with smaller maxima in January and March, and minima in April and October, November, December. The inclusion of these facts might modify Mallet's curve for the Southern Hemisphere, but it does not appear that they point to any connection between earthquake-frequency and the season of the year.

One of the maps exhibited showed, by shading, the earthquake-frequency of the shocks in various parts of New Zealand, the region most effected being a portion of Cook Strait, included in the triangle Wellington, Blenheim, Wanganui; the next shade of frequency includes Christchurch, the next, Nelson. There is an isolated district of local earthquakes round Rotorua and Tarawera. On my other map were marked the epicentra of 35 earthquakes for which the data were sufficient to ascertain them with any degree of probability, and I have since been able to determine more or less exactly the origins of a few of the earthquakes of 1891–1892. The two chief sources are situated —(1) 10 miles north of Lake Sumner, or about 80 miles north-northwest of Christchurch. Hence proceeded the shock which on the 1st of September, 1888, threw down the upper portion of the spire of Christchurch cathedral. To the same origin I am able definitely to assign 10 other shocks, and probably many more belong to it. (2) 45-50 miles north-northwest of Wellington, in Cook Strait. This and some other origins near it are accountable for most of the New Zealand shocks, the average intensity being very low, III.—IV., on the Rossi-Forel scale.

The method used for finding the origins has been, in general, founded on the observed times of the shock at the several places at which it was felt, with the help of the isoseismals, when the effects were sufficiently definite to assign the degree of intensity on the Rossi-Forel scale.

One somewhat striking point in connection with all the recent earthquakes in New Zealand, is the low velocity of propagation they possess (less, with one exception, than 20 miles a minute). At first this made me doubt the correctness of the calculations, but the large number of shocks for which the velocity can now be approximately ascertained renders the results tolerably certain. In the solitary exception (an earthquake of the present year, which I am still investigating) the velocity is probably between 45 and 55 miles per minute. The depth of the origin has not been found in many cases, but in those for which the solution of the equations is most satisfactory, the depth is in each case about 24 or 25 miles below the surface.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Some Recently Discovered Trilobites with Appendages.

The past winter the Geological Department of Columbia College came into possession of some extremely interesting specimens of *Triarthrus Beckii*, which were discovered by Mr. W. S. Valiant, now of Rutgers College, in the Utica shales at Rome, N.Y. They were entrusted to W. D. Matthew, our fellow in geology, for complete description, and Mr. Matthew's paper, recently read before the New York Academy of Sciences, will appear in the Transactions of the Academy for May. Owing to the unavoidable delay in their issue, and because the subject is such an interesting one, this preliminary announcement is made. The Trilobites possess two undoubted antennæ that come out together

from under the front-central portion of the head-shield, and project forward. They are jointed and entirely analogous to the antennæ of living crustaceans in structure. In full or in stumps, they have been identified on upwards of fifty individuals, some twenty of which belong to Columbia College. On one specimen, where the cheeks have been broken away, Mr. Matthew has detected comb-like structures, which we suppose to be gills. Leg-like appendages are well preserved, opposite the divisions of the body.

At the posterior end of the pygidium, tetson-like appendages can be distinguished, which are of great interest, and which are regarded as perhaps indicating an ability in the animal to propel itself backwards, as does the lobster, although its ordinary motion would be forwards, by means of its legs. Mr. Matthew brings out some other interesting facts and deductions, which will be illustrated by drawings in the full paper. J. F. KEMP.

Columbia College, May 26.

Cedar Waxwing.

IN view of the articles published in your paper during the past few months regarding the plumage of the cedar waxwing (*Ampelis cedrorum*), it may be of interest to call attention to a paper published in the "Transactions of the Norfolk and Norwich Naturalists' Society," Vol. III., pp. 326-344 (read Nov. 2, 1881), by Henry Stevenson, in which there is a very full discussion of the plumage of the allied Bohemian waxwing (*Ampelis garrulus*).

The presence of the wax-like tips in nestling birds is here recorded, and several captures of young in this plumage are referred to; the first nestling secured with red tips to the wing-feathers seems to have been taken by one of Mr. Wolley's collectors in Finnish Lapland in 1856. WITMER STONE.

Academy of Natural Sciences of Philadelphia.

Native Lead.

IT may be of interest to mineralogists to note a new locality for native lead, which occurs near Saric, Sonora, Mexico, about 35 miles south of this place.

The metal occurs in thin scales; and pellets, like small shot, have been reported, but I have not seen them. The scales seem to approach a rectangular form, and have been found nearly an inch long.

The gangue rock is evidently a pyrocene, of pale-green color, streak yellowish. The accompanying minerals are iron oxides, with traces of manganese, and carbonate of lime.

C. W. KEMPTON.

Oro Blanco, Arizona, June 8.

The Ancient Egyptian Language.

IT is the growing opinion of scholars that the ancient Egyptian language has more intimate Semitic relationship than has been generally admitted. The grammatical construction of Egyptian is distinctly Semitic; the pronouns, prepositions, and other particles are traceable for the most part to Semitic roots; the Semitic system of pronominal suffixes is often used. Benfey sought to establish this affinity by various considerations, grammatical and lexicographical, and the conclusion to which he came was that the Semites are only one branch of a great family, which includes not only the Egyptian, but also the other languages of Africa. De Rougé, Ebers, and Brugsch have declared their belief in the descent of the Egyptian from the same stock as Semitic. Dr. Fritz Hommel, in his recently-published brochure, "*Der babylonische Ursprung der ägyptischen Kultur*" (Munich, 1892), brings forward many proofs showing the Semitic origin of the Egyptian language and writing. He not only specifies a number of identical words, but shows the grammatical relations of the two languages. He also puts side by side some thirty-five characters which resemble each other in the two languages, both in form and signification, and even in sound. Dr. Hommel maintains that Egyptian culture originated in Babylonia.

In this connection we may mention the interesting fact that the Egyptian documents recently discovered in Palestine, rigorously transcribed in Hebrew characters, gave almost everywhere the regular Hebrew forms in the Bible, without change or correction. CHAS. H. S. DAVIS.

Meriden, Conn.

Funnel-Shaped Clouds.

DURING the afternoon of May 17 there appeared not far northeast of Colorado Springs numerous cloud-masses resembling incipient thunder-storms. They were not so large as ordinary thunder-storms. From a cumulus mass depended the fringes that mark the storm-cloud, but they were unusually long as seen in profile at a distance. Only a little rain fell from any of them, and none from most of them. From the centres of several of them also depended funnels or narrow cones. In one case this column reached fully one-fourth of the angular distance to the ground, the others nearly as far. The columns changed their form somewhat, but I could not discover any marked swaying or writhing, perhaps owing to the fact that those observed were at a distance. At the time the surface winds were light and variable, but the following days have been marked by very violent winds. These were nearer the tornado than I ever before saw in Colorado. G. H. STONE.

Colorado Springs, Col.

Glaciers in the United States.

AT this season of the year many scientists are preparing to visit and study the glaciers of Switzerland, that country being the Mecca of geologists who are converts to the glacial theories. I desire to call the attention of the readers of *Science* to the fact, that here in Pierce County, Wash., we have a system of glaciers surrounding Mount Tacoma, beside which those of Mt. Blanc are insignificant, both in area and distribution.

The glaciers of Mount Tacoma are eighteen in number, and are arranged in radial lines from the central dome of the mountain, which is 14,450 feet in altitude. As this mass rises from the sea-level, it is the most conspicuous peak in the United States. The limit of perpetual snow on the spurs is 4,000 feet, while the glaciers and snow-fields that lie in the cradles extend as low as 2,700 feet. With care, the glaciers and spurs are not over-dangerous travelling. The scenery is superb, and well repays the many campers who yearly seek the mountain slopes for health and recreation. About fifty persons have attained the summit, including two ladies. The glacialist may there study moraines, terminal, medial, and lateral, and make observations on the flow of ice to his heart's content.

If any of your readers desire further information upon this subject, it may be obtained gratis by addressing

FRED. G. PLUMMER,
Secretary Washington Alpine Club, Tacoma, Wash.

Tacoma, Wash., June 1.

Binocular Vision.

Professor LeConte's remarks on my note about binocular vision seem to call for a word or two in addition from me. Of course I should not have troubled the readers of *Science* with my ways of looking at things, had I not known that they were unusual, and quite at variance with everything accessible to me on the subject, including Professor LeConte's own excellent little book, to which he makes reference, and had I not also been quite certain of the subjective part of the phenomenon. It is now about ten years since I noticed it first. Though a student of physics, I had not then read enough of physiological optics to have met with any thing on this subject, hence I had not been told what I must expect to see — a fact that I have no doubt is responsible for my unhappy deviation from established rules. Since that time I have tried the experiment under every available set of conditions — almost whenever I have found myself looking at any kind of a pattern. I have tried it with perfectly flat decoration, relief, and actual net-work, such as the bottom of a cane-seated chair, or a coarse wire-cloth, always with the same

result. The illusion is quite complete; I seem to be looking at an actual pattern. The use of a material point of regard, as the tip of the finger, was not, as Professor LeConte seems to have understood me, to aid in properly fixing the axes of the eyes, but simply to make sure on which side of the actual pattern the horopter lay — the all-important fact in the experiment. I may add, that in my case the coalescence of the images is easier with a more distant than with a nearer point of regard — contrary to Professor LeConte's experience. It seems to me that it would be valuable to secure some additional evidence as to the way in which the phenomenon strikes a person who has had no previous knowledge of its existence, say by using a stereoscope without lenses, fixing the distance of a point in monocular vision and then suddenly introducing a pattern, the observer being simply asked to estimate its distance. In closing, let me say that I lay no stress on my remarks in explanation of my own case. It really is more or less of a mystery, but it surely need not remain so. The abnormal eyes of Dalton did great things for the theory of color vision, and indeed it is from the abnormal more than from the normal cases that fruitful trains of thought are apt to take their rise. I esteem myself fortunate to have interested Professor LeConte, and I hope that this is by no means the last thought that he will give to the matter.

ARTHUR E. BOSTWICK.

Montclair, N.J., June 19.

A Night-Singing Cat-Bird.

PERHAPS it is not a rare occurrence, but I never heard of such a thing before, and I give the incident for what it is worth. A few evenings since I heard a cat-bird sing for nearly an hour just before midnight. The weather was mild, with not enough moonlight to cast a shadow. The bird's song was somewhat intermittent and scarcely so rapturous as his usual sunset or sunrise singing. In the intervals there occasionally came one or two of the mewing utterances characteristic of the bird.

A. STEVENSON.

Arthur, Ontario.

Is it a Paleolith?

A STONE axe has just been found in a field about eight miles northeast of this place, which very nearly proves (if not quite so) that man existed during, or prior to, the glacial period in North America. It was found by A. A. Newlin, on the summit-level in this (Parke) county, Indiana, on the south side of Sugar Creek. It is $6\frac{7}{10}$ inches long, $2\frac{1}{2}$ inches wide on the blade, $4\frac{3}{10}$ inches wide at the groove (or eye of our steel axes), $3\frac{1}{2}$ inches wide at the "back," or "poll," and is $1\frac{4}{10}$ inches thick, and, I am confident, was, when first made, nearly two inches thick.

One side is ground flat, and by glacial action, without any doubt. By that grind the groove was planed almost out on that side, and has been re-cut or filed out by some Indian long ages after the Indian who first fashioned the axe. The striations run from edge to poll, and the axe was moving edge forward, as the striations indicate, for they are deeper cut toward the edge, and weaker, become shallower and less distinct, toward the poll.

The opposite, or convex, side of the axe has been striated just enough to produce a distinct plane, which inclines to (or from) the flat side about eleven degrees.

The poll, the ends (as timber men call that part of the axe nearest to and farthest from the hand when using), the present convex side, and the grooves around the ends show the deepest and oldest weather-pits. Then the glaciated, flat side shows the next oldest weathering. Next, the newly-deepened groove on the flat side, and, also, a little deepening of the groove on the convex side, where the grinding had made the groove somewhat shallow, show the next oldest weathering; and, last, the smooth, whetted edge shows very little weather wear.

This axe was found about one hundred miles north of the southern boundary of the glacial drift on the Wabash River. I have found eleven places in the county where the rock, in place, is strongly and clearly glaciated, and three places have been found by other parties. The erratic bowlders which are striated on one to five sides are countless (to say nothing of those not marked), and I have examined them and studied them a great deal, and think I am not a bad judge of their comparative exposures and decompositions. As a result of my experience and judgment, I am strongly inclined to believe that this axe was made before, or during the glacier. That it was lost, or in some way fell into the sweep of the glacier and was ground flat on one side and striated a little on the other. That, after the glacier had receded, it was found, repaired, sharpened, and used till the steel tomahawk took its place, when it was cast aside. I feel confident that experienced archæologists will so decide.

JNO. T. CAMPBELL.

Rockville, Indiana.

Cloud Formation.

I wish to call the attention of meteorologists to a rather peculiar phenomenon witnessed by me several times last winter.

The slough between King's River and the San Joaquin, overflows in seasons of high water, causing dense growths of tule (*Scirpus lacustris*, or round tule, and *Typha latifolia*, or flat tule), often ten feet high. The buccaroes of the large stock ranches burn the dead matter in winter, to clear the land that the stock may get the young feed.

On Jan. 28, at 3.30 p. m., I noticed one of these fires. The wind was northwest, slight, and quite warm; the weather had been showery for a few days previous, but, saving a few clouds of the cirrus type, the sky was clear. The fire was not extensive, but made a dense smoke which rose in a nearly perpendicular column, nearly 2,000 feet, when it met a counter current of air from over the Coast Range, as evidenced by its drifting abruptly away to the northeast.

All this is a natural result of the topography of the country; but what arrested my attention was a cloud of the cumulo-stratus type, resting on the top of the column at the point of flexure, like a cap. It did not appear to drift away, nor did it grow larger or diminish, save that from its base it gave off a cloud of the nimbus type, that mixed with the smoke and gradually increased and extended, till, at about 10 o'clock p. m., it extended across the northern horizon, like a dense rain cloud. Meanwhile, other clouds began forming at sunset, and it rained before morning.

On Jan. 29, it cleared away, another fire was started, the smoke rose in a column to the same altitude, struck the current, and drifted away, no cloud forming. The same thing happened on the 31st. On Feb. 1, the apparent conditions were the same, save a few clouds came in from the coast, but were soon dissipated. In the afternoon I saw the fire start, and watched it. The smoke rose as before, and struck the upper current of air. Immediately a cloud formed. In less than half a minute it had reached its usual size, as large as the column, which it seemed to cap. It was a dusty day, so the column was often broken. I saw it blown from under the cloud, and a new one form three times in about five minutes.

I now noticed that, whereas the smoke drifted down the wind, with its upper surface a horizontal plane, the liberated clouds ascended into the wind in the manner of a kite. Once outside the influence of the smoke, they were dissipated like the rest of the clouds. General showers prevailed throughout the valley for the next three days.

Reasoning from my limited knowledge of physics, I might think the cloud was caused by a column of heated and vapor-laden air rising with the smoke, and being cooled by coming in contact with the upper current, causing its vapor molecules to agglomerate into cloud particles; but, for various reasons, I think this inadequate. I have since seen the fires several times, with a southerly wind, which generally brings our rain, but no cloud formed.

I have seen a theory advanced that vapor molecules need some solid nucleus to start the process of agglomeration. Can any one tell if this be so, and, if it is so, the rank that carbon takes as a condenser?

I would also like to know why no cloud formed save in a "chronic" state of the weather; and finally, why did the liber-

ated clouds float into the wind in opposition to all known physical laws?

I cannot help but think that had a meteorologist been on the spot, he would have been able to throw light on the subject of cloud formation and precipitation. ALVAH A. EATON.

Riverdale, Cal., May 20.

Birds that Sing in the Night.

I WAS somewhat surprised that the writers under the above caption in the Dec. 2 and 16 Nos. of *Science* omitted some of the most familiar night-singers of the Atlantic seaboard of the latitude of New England. While never having heard some of those mentioned, I have often heard the field-sparrow, *Shizella pusilla*, break forth into rapturous song by night, especially if the moon be shining, at the nesting period.

Another of the most common night-singers is that songster of songsters, the prince of the thrushes, the Wilson's thrush, or "Marten," *Turdus fuscescens*. During late May, June, and early July he prolongs his vespers till nine or ten o'clock, and often breaks forth at intervals throughout the rest of the night.

Another songster is the cuckoo, whether the yellow or blue-billed, I know not. He generally sings in the low ground, and is popularly supposed to foretell rain. "Oft in the stilly night," while the moon was playing hide and seek with the clouds, and a thin mist was creeping slowly over the landscape, have I heard the "rain-bird's" voice come weirdly from the swamps. At first low and indistinct, perhaps owing to the inequalities of the atmosphere, a few steps may suffice to place one so it is heard with startling distinctness. At such times the sweetness of his voice is enhanced, and, as the clear, liquid notes swell on the stillness, we forget to quote Shakespeare: "The nightengale if she should sing by day, would be thought no better a musician than the wren," but rather burst into the rapturous quotation of a later poet:—

"O cuckoo! shall I call the bird
Or but a wandering voice!"

Then we forget the songster's ill-repute as an egg-thief, forget his benefits to the agriculturist, and love to feel the author of this melody is of supramundane origin, and not of earth, earthy. If a few birds' eggs mixed with a diet of tent caterpillars will make such a voice, let him have them, by all means. I heartily believe the bluejay is author of most of the mischief laid to his door, as I have seen him take both eggs and young of the smaller birds.

The horned lark, *Otocoris a rubea*, is the most common night-singer in California, at least the valley. ALVAH A. EATON.

Riverdale, California.

Books for Children.

MR. FRANK WALDO, in *Science* for June 16, asks for lists of books that will enable children of ten to call by name the natural objects they meet in their rambles.

He says that those books which he has seen do not give the "necessary details." Therein lies the difficulty with children of ten years of age. As soon as the necessary details are given so many scientific words have of necessity been used that the results are beyond the comprehension of the clientage to which he proposes to cater. Those whom he wishes to reach, need just what he himself states at the end of his letter he was so fortunate as to have, viz. a personal guide and instructor.

The best book, for children, about flowers, with which I am acquainted, is Gray's, "How Plants Grow." Bright children of 12, if properly instructed, could use it in the woods and fields and find out, without the presence of a teacher at the time, the name of any of the larger and more interesting of the flowers, excluding, of course, the golden rods, daisies and other compositæ.

In the correspondent's state, New Jersey, there are several hundred species of birds, and many of them have nests and eggs so nearly alike, that by them even oölogists cannot tell the species with certainty. Most birds give several different notes, some an extensive range; nearly all sing differently at different times of the year. The bird book asked for — one that will enable a person of ten or any other age to name "free birds" without a teacher — is an impossibility.

The best book on birds, is probably Coues's "Key to North American Birds," but it could not be used by children under 15.

French's "Butterflies of the Eastern United States," is probably rudimentary enough for children of 12–14, provided a little preliminary work were done by an older person who understands the vocabulary used by the author. My own "Trees of the Northern United States" deals only with the leaves, bark, and occasionally the fruit, and contains as few scientific words as possible, and those are all defined with added illustrations whenever at all necessary. This fact, and its containing an accurate picture of the leaf of each species, ought to enable even those of ten to use the book. Binney's "Land and Fresh Water Shells of North America" contains illustrations of all the species, and, as far as these will enable one to name shells, ought to be all right for children. I attempted in my "Mollusks of the Atlantic Coast" to make an easy book to be used by children of 14 or more in naming the shells of the shore.

The beetles are too numerous in species for any book, large or small, expensive or otherwise, to enable children or even grown people to name all or even a majority of them. The moths are also very numerous in species and so far no one book, cheap or high priced, names them all. AUSTIN C. APGAR.

Trenton, N. J.

Teaching of Biology.

THE recent discussion in the pages of *Science* as to the methods of teaching biology now in vogue in this country, has brought out much that is of interest to all who seek to present that subject in a fair and unbiased manner to their students. Ignoring the controversial phase, which too many of the letters have shown, is there not, after all, the question yet remaining—How shall biology be taught?

Circumstances are alike at no two colleges in this country; differences of courses, students, surroundings and many other factors make it necessary that each teacher should solve the problem for himself. But in a large number of institutions the plan of study is such that unless a student elects to specialize in biological lines he will receive but one, or at most two, terms of training in natural history.

In such a case what is the best plan to adopt? A course in botany will give the student a slight acquaintance with some of the flowering plants only if the course be the one usually given in such cases. On the other hand, a course in zoölogy would leave the student with no knowledge of plants and but little of animals. He will receive no farther work in either line during his course. What will be the best for *him* in his life after leaving college?

After much consideration, the writer has sought to find a way between the two horns of the above dilemma by seeking to present fundamental principles, illustrating and demonstrating them by examples taken from either the animal or vegetable kingdom, as might be most advantageous. In this work the form itself has received far less stress than the principle which it illustrated, and the bearing it might have on the question whether the course was more botanical than zoölogical was not for a moment considered.

It was found convenient to begin by assuming that, in a degree, animals and plants are machines for the transformation and utilization of energy; adding to this, during the course, a consideration of the problems which must be successfully met to ensure existence and comparative study of the various ways in which these problems are solved.

The result of this course has been to encourage me to continue along these lines, reserving for psychology, which follows, the task of checking any tendency to regard living things as machines only. Looking over the ground covered, I find that nearly two-thirds of the examples chosen to illustrate the various principles were from the vegetable kingdom. Surely, whatever else it may be, this is not a course in zoölogy masquerading under

the guise of one in biology. Whether it agrees with the original meaning of the word "biology" or not, I care but little, for many other words of our language are very far to-day from their original significance, while a study of the principles shown by "matter in its living state," is certainly not very far from the significance of the words from which "biology" is derived.

H. T. Fernald.

State College, Pa., June 9.

BOOK-REVIEWS.

Fifteenth Annual Report of the State Board of Health of the State of Connecticut, for the Seven Months Ending June 30, 1892. New Haven, 1893.

In addition to the customary features, the statistics upon the health of towns and the reports of local boards of health, this volume contains three papers under the heading "Miscellaneous." The first of these is by Dr. Herbert E. Smith, upon "Connecticut River Water as a Source of Typhoid Fever at Hartford." The unusual number of cases of typhoid fever in Hartford in the winter of 1891–92 led to an investigation by Dr. Smith, under the auspices of the State Board of Health. Dr. Smith has fixed the responsibility for the outbreak upon the water of the Connecticut River, which was supplied to citizens of Hartford during a large part of the months of October, November, and December. The period when the disease specially prevailed "corresponds with the time when cases originating in the use of the river-water must have appeared." From the evidence adduced by Dr. Smith there seems every reason to believe that typhoid germs, carried to the consumer by the river-water, were the cause of some fifteen deaths that otherwise might not have occurred. Dr. Smith suggests that the germs might have come from the sewers of Springfield, twenty-five miles up stream, and this seems certainly a likely supposition, if we are to judge from the history of similar epidemics.

The paper which follows this is by Dr. Charles J. Foote, upon "The Filtration of Water." It relates some experiments upon the Pasteur-Chamberlain filter, certain of which seem to indicate that defective packing around the porcelain may lead to the appearance of germs in the filtrate. As a result, partly of his own, partly of others' investigations, Dr. Foote concludes with the following practical advice: "We may conclude then, first, that the porcelain cylinder of a Pasteur filter should be cleansed once a week at least by boiling in water for an hour. A simple washing is not sufficient, since, when the porcelain is replaced, the living bacteria still remain in its pores and come through into the filtrate as soon as the water is turned on; second, that the filter should not be put in a position where it is near a range or any other apparatus giving out much heat, but put in a cold place; third, that a properly-constructed filter should be obtained, so that there is no chance of a leak around the packing."

The third paper is entitled, "Abstracts from a paper on the Duty of Public Disinfection following Acute Infectious Diseases," and is a remarkable production, as the following pregnant sentences may suggest: "One afternoon last December I sat upon the deck of the revenue cutter, 'Lot Morrill,' with the secretary of our State Board of Health." . . . "Smallpox has been lashed to hell by the agent vaccination, and like a whimpering hound is held securely in leash." . . . "Arms, arts, literature, science, all have their rewards, but not one of them surpasses in the magnificence of its gifts those of which the god-like science, medicine, is capable."

The Archæan Formation of the Abukuma Plateau. By B. Koto. Journal of the College of Science, Imperial University, Japan. Vol. V., 1893. Plates.

This article of nearly one hundred pages and six well-executed plates shows us that Japan is not behind the western countries in scientific studies. Except a few cabalistic signs on the cover, and a few more on one page at the end of the article and a foot-note

or two, there is nothing to indicate that it might not have come from an English or American printing office. Yet the whole of it, plates and text, is the product of a Japanese office. It is also a striking example of the extended use of the English tongue when a paper of this character appears in our language instead of French or German.

The paper is the result of several years of study by the author, and shows great industry and research. The Archæan is divided into an upper and lower division. In the former are placed the Gozaisho and Takanuki series, and in the latter the Laurentian. The Gozaisho series is estimated to have a thickness of 10,000 metres. The Takanuki series was found too distorted to estimate the thickness. Many details of sections are given, and there is also an extended discussion of the origin of the various rocks, and of their lithological characters. The paper is worthy the attention of students of the Archæan formations.

JOSEPH F. JAMES.

May 5.

The Microscopical Examination of Potable Water. By GEO. W. RAFTER. New York, D. Van Nostrand Company. 160 p. 18°. 50 cts.

THIS little book, forming No. 103 of the Van Nostrand Science Series, fully bears out the character of preceding volumes, and, like them, will be well received by all. The plain language used puts it at once within the limits of beginners in microscopical water analysis, and, at the same time, it affords a handy *résumé* of work done for the use of the professional student. Care has evidently been taken by the author to give as completely as possible "the state of the art" to the date of issue, and in this particular the book is in advance of some of its more pretentious rivals.

It is divided into two parts, the first treating the subject qualitatively, the second quantitatively, while appended is a bibliography of water examinations, both from the chemical and biological standpoint. These two fields of research, chemical and biological, are each given their proper place throughout the volume, and, more fairly than is usually the case, the author believes them of equal value when in conjunction with a study of environment, and equally valueless when used alone. It has become a habit among biologists, latterly, to decry chemical methods altogether, while chemists, in their turn, have been rabid in their defence, hence the stand taken by Mr. Rafter is particularly refreshing, and the more so that he is eminently a biologist, and has arrived at his conclusions through calm reasoning. C. P.

AMONG THE PUBLISHERS.

WE have received from D. Appleton & Co., their "Guide Book to Alaska and the Northwest Coast," prepared by Eliza R. Scidmore. It gives a quite minute description of the whole coast of North America, from the Strait of San Juan de Fuca to the Aleutian Islands, with brief notice of the more northern portions of the great Alaskan peninsula. Though written for tourists, it is by no means confined to the superficial aspects of the country, but gives attention to the geographical features, the industries and commerce, the mountains and glaciers and the native tribes, presenting a larger amount of information than might be expected in a book of one hundred and fifty pages. Such a book is necessarily a compilation from various sources; but the author has evidently studied the best authorities, and has supplemented them by her own observations. The country described has certain special attractions for tourists, especially those of scientific proclivities, since the geological formations, the flora and the native inhabitants present some remarkable peculiarities. Many scientific observers, as well as other tourists, have already visited the region, especially its southern part; yet even now it is so little known that visitors who wish to see as much as possible there will find a guide-book indispensable. To such persons, therefore, this handy volume, which is well illustrated with maps and pictures, cannot fail to be useful.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

For exchange.—I wish to exchange Lepidoptera of South Dakota and other sections, for Lepidoptera of the world. Will purchase species of North America. Correspondence solicited, particularly with collectors in the Rocky Mountains, Pacific coast and Hudson's Bay regions. P. C. Truman, Volga, Brooking county, South Dakota.

For sale.—Wheatstone Bridge wire, made to order, new and unused. Price, $10. W. A. Kobbe, Fortress Monroe, Va.

For sale or exchange.—One latest complete edition of Watt's Dictionary of Chemistry, in fair condition; one thirty volume edition (9th) of Allen's Encyclopædia Britannica, almost new. Will sell cheap for cash or will exchange for physical or chemical apparatus. Address Prof. W. S. Leavenworth, Ripon College, Ripon, Wis.

Exchange.—One celestial, one terrestrial globe, one lunatettis and charts, celestial maps, diagrams and ephemeris from 1830 to 1893, astronomical works, all in good condition. Will sell cheap or exchange. Make offer. C. H. Van Dorn, 79 Nassau St., New York.

The Rev. A. C. Waghorne, New Harbor, Newfoundland, wishes to sell collections of Newfoundland and Labrador plants, all named by competent botanists. He is going on a missionary journey along the Labrador coast, from the middle of July till October, and in return for much needed aid towards (Episcopal) Church purposes in that region, will be glad to be of service to any botanists who may write to him. Letters posted in the U. S. up to July 1 will reach him at the above address, and if posted later will be forwarded.

For exchange—I wish to exchange cabinet skins of Californian birds or mammals for any book on the following list, books if second-hand to be in good order. Manual of Vertebrates, fifth edition, D. S. Jordan; Nests and Eggs of North American Birds, Oliver Davie; Marine Mammals of the West Coast of North America, C. M. Scammon; The United States and Mexican Boundary Survey, Vol. II., Zoology, S. F. Baird. F. Stephens, Witch Creek, San Diego Co., Cal.

Minerals for exchange—John Hall, Rollo, Wilmington, Delaware.

Wants.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

A ZOOLOGICAL collector and taxidermist of ten years' experience in the field is now open to engagement, for either field or laboratory work. References furnished. Address Taxidermist, Box 75, White Sulphur Springs, West Va.

WANTED.—A set of Allen's Commercial Organic Analysis, 4 vols. Vols. I. and II. particularly desired. Condition not important, all leaves being present and in place. Address Charles Platt, 34 Lewis Block, Buffalo.

WANTED.—Second-hand copy of Ehrenberg's Radiolaria, Berlin, 1875. Selected diatom slides, cash or both in exchange. D. C. Lewis, M.D. Skaneateles, N. Y.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y.

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinæ in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi, cyrtonyx montezumæ, deudragapus franklini, lagopus welchi, tympanuchus cupido* and *pediœcetes phasianellus*. Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3022 Fifth Avenue, Pittsburgh, Pa.

A COMPETENT TEACHER of botany in college or university is open to engagement. Address L., Box 86, Rochester, Mich.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.